ENZYMATIC TREATMENT OF STARCHY FOOD PRODUCTS FOR SHORTENING THE TEMPERING STEP

CROSS-REFERENCE

This application is a continuation of PCT/DK02/00596, filed September 12, 2002, which claims priority of Danish application nos. PA 2001 01354, filed September 18, 2001, and PA 2002 00052, filed January 14, 2002, and the benefit of US provisional application no. 60/347,276, filed January 11, 2002, the contents of which are herein incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to the preparation of an edible product from raw materials comprising starch and water by heating, cooling, holding and drying.

BACKGROUND OF THE INVENTION

The preparation of some starch-based food products includes a holding step (sometimes known as tempering or ageing) intended to make the starch retrograde sufficiently to make the product acceptable for further processing. This may typically involve holding from 10 to 48 hours at room temperature.

An example is the production of certain snack products (sometimes called third-generation or 3G snacks) in a process including extrusion cooking, followed by cooling, holding and drying to make snack pellets which are expanded by heating (e.g. by frying in oil) to make the final snack product.

Another example is shredded cereals made by cooking whole grain (particularly wheat), followed by cooling, tempering, shredding, forming into biscuits and baking.

The ageing step is by nature a time and space consuming step, and a shortening of this step will give significant advantages to manufactures such as the possibility of reducing floor and rack space or increase production.

CA 2015149 and CA 2016950 relate to processes for preparing a shredded wheat product by use an isoamylase or an R-enzyme.

SUMMARY OF THE INVENTION

The inventors have found that the addition of a maltogenic alpha-amylase, an alpha-amylase or a microbial pullulanase to starch-based raw materials accelerates the retrogradation

and thus allows a shortening of the holding period.

Accordingly, the invention provides a process for producing an edible product, comprising the following sequential steps:

a) mixing a maltogenic alpha-amylase, an alpha-amylase or a microbial pullulanase with raw materials comprising starch,

b) heating so as to at least partially gelatinize the starch,

c) cooling,

d) holding to effect at least partial retrogradation of the starch, and

e) heating, e.g. so as to bake or dry the product.

DETAILED DESCRIPTION OF THE INVENTION

Food product

The food product may be snack pellets, a snack product (e.g. a third-generation snack), or shredded cereal (e.g. shredded wheat) for use as a breakfast cereal.

Snack pellets and products

According to the invention, snack pellets may be produced by a process comprising the following sequential steps:

a) mixing a maltogenic alpha-amylase, an alpha-amylase or a microbial pullulanase with raw materials comprising starch,

b) extruding and heating the mixture so as to at least partially gelatinize the starch,

c) cooling and holding to effect at least partial retrogradation of the starch, and

d) heating and drying.

The raw material mixture generally contains water, typically up to 32 % water (e.g. 20-32 %), and may optionally be preconditioned by heating, e.g. up to 95°C for 20-240 seconds.

The extrusion cooking may be done in a single-screw or double-screw extruder with a residence time of 30-90 seconds. The extruder will typically comprise a cooking zone at 80-150°C and a forming zone at 65-90°C. After the extrusion with heating, the mixture may be formed into long rods, typically having a temperature of 60-100 °C (particularly 70-95°C) and a moisture content of 25-30 % or 20-28 %. The holding (also termed aging) may take 8-24 hours (particularly 10-16 hours). Before or during the holding, the rods may be cooled, typically to 15-30°C. The holding serves to effect at least partial retrogradation of the starch, either of the amylose component, the amylopectin component or both. Advantageously, the maltogenic alpha-

amylase, alpha-amylase or microbial pullulanase added according to the invention accelerates the retrogradation, so that the holding time may be shortened. The end-point may be conventionally determined by testing the hardness and brittleness of the pellets.

After ageing the rods may be cut into pellets.

The drying of the pellets may be done at 70-95°C for 1-3 hours to reach an exit moisture of 6-8 % in the snack pellets.

The dried snack pellets may be stored or distributed to a snack processor. The snack pellets may then be expanded by heating , e.g. by frying in oil or puffing in hot air or in microwave or infrared oven.

Shredded cereals

According to the invention, shredded cereals may be produced by a process comprising the following sequential steps:

a) mixing a maltogenic alpha-amylase, an alpha-amylase or a microbial pullulanase with raw materials comprising starch,

b) cooking so as to at least partially gelatinize the starch,

c) cooling and holding to effect at least partial retrogradation of the starch,

e) shredding, and

f) baking.

Shredded cereals may be made by cooking whole grain with the maltogenic alpha-amylase, alpha-amylase or microbial pullulanase in water, followed by cooling, tempering, shredding, forming into biscuits and baking.

The whole grain may be wheat (e.g. white wheat), rice or corn. The cooking may be done for 30-35 minutes at atmospheric pressure or 2000 hPa to reach 45-50 % moisture after removal of excess water. The holding (or tempering) may take 8-28 hours with cooling to 15-30°C. After shredding, the shreds may be stacked to make a biscuit, and this may be baked at 200-315°C to around 4 % end moisture.

Maltogenic alpha-amylase, alpha-amylase or microbial pullulanase

The invention uses an enzyme which is a maltogenic alpha-amylase, an alpha-amylase or a microbial pullulanase. The enzyme may suitably have a pH optimum in the range 5-9.

The enzyme may suitably have a temperature optimum in the presence of starch in the range of 30-90°C, preferably 50-80°C, particularly 55-75°C, e.g. 60-70°C. The temperature optimum may be measured in a 1 % solution of soluble starch at pH 5.5.

The enzyme is typically used at a dosage of 0.1-20 mg enzyme protein per kg of dry solids in the raw material, particularly 0.5-5 mg/kg.

The alpha-amylase (E.C. 3.2.1.1) may be derived from *Bacillus*, particularly *B. licheniformis* or *B. amyloliquefaciens*. The alpha-amylase may be used at a dosage of 1-100 KNU/kg raw material, e.g. 5-20 KNU/kg. The KNU (Kilo Novo Unit) for amylase activity is defined in WO 96/33267.

The maltogenic alpha-amylase (E.C. 3.2.1.133) may be derived from *B. stearothermophilus*, e.g. strain NCIB 11837 described in EP 120693, or it may be a variant described in US 6162628. The maltogenic alpha-amylase is typically used at a dosage of 20-5000 MANU per kg of dry solids in the raw materials, particularly100-1000 MANU/kg. The MANU unit is defined in US 6197352 B1.

The microbial pullulanase (EC 3.2.1.41) may be bacterial, e.g. derived from a strain of *Bacillus*, in particular *B. naganoenis* or *B. acidopullulyticus*, a strain of *Clostridium*, in particular *C. thermosulphurogenes* or *C. thermohydrosulphuricum*, or a strain of *Pyrococcus*, in particular *P. woesie* or *P. furiosus*.

EXAMPLES

Example 1: Use of a maltogenic alpha-amylase in production of rod type snack pellets

Rod-type snack pellets were produced with addition of a maltogenic alpha-amylase. The maltogenic alpha-amylase tested was a thermostable variant of a maltogenic alpha-amylase from *Bacillus*, described in US 6162628 at a dosage of 1000 MANU/kg of raw material. A control was made without addition of the maltogenic alpha-amylase.

The following raw materials were mixed: Potato starch, wheat flour, maize flour, potato granules, salt, paprika, vegetable oil, emulsifier and flavouring.

The raw materials were treated by pre-conditioning at 20 - 95°C for 1-2 minutes followed by extrusion at 80 -150°C for 30-90 seconds, and forming at 65- 90°C into long rods.

After forming the rods were placed on racks and stored 16-24 hours before cutting. At the start of ageing the rods were rubber like and did not break when bended. A simple bending test was performed several times during storage, and the rods were judged to be ready for cutting when they readily broke at the bend point when bended.

Finally, the rods were cut and expanded by deep-frying in palm oil at 180°C for 9 - 11 seconds.

The results were that the rods made with the maltogenic alpha-amylase were ready af-

ter 18-19 hours whereas the control without the maltogenic alpha-amylase was ready after 24 hours. The expanded pellets from the enzyme trials did not show any significant differences compared to the reference on physical parameters.

Example 2: Effect on snack texture

Snack pellets were produced according to a sheeted pellet procedure with addition of a maltogenic alpha-amylase and alpha-amylases..

The following raw materials were mixed: Potato granules, glucose, salt, vegetable oil, mono- and diglycerides as emulsifiers, and dicalciumphosphate.

The raw materials were treated by preconditioning at 20-80°C for 1-2 minutes, followed by extrusion at 80-130°C for 30-45 seconds, forming (sheeting) and drying of the single pellets. The pellets were allowed to rest for at least 24 hours to assure optimal water migration, before expansion. Expansion was done in palm oil at approximately 180°C for 9-11 seconds.

The texture was judged by a panel of 4 persons. The maltogenic alpha-amylase and alpha-amylases and dosage used and the observed effect were as follows:

Enzyme	Dosage/kg raw material	Effect
B. stearothermophilus maltogenic alpha-amylase	10000 MANU	Sample was more brown than reference. Some off flavour (Maillard reaction).
Thermostable maltogenic alpha-amylase variant	500 MANU	Very crispy, brittle.
	1000 MANU	Very crispy, brittleness more distinct at higher dosages
B. licheniformis alpha-amylase	12 KNU(T)	Very firm surface.

All the enzyme-treated products looked nicer than the reference with fewer, smaller and better distributed air bubbles after expansion.